REMARKS

Claims 1 to 16 are all the claims pending in the application, prior to the present Amendment.

Claims 1 and 4-12 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Kamio et al (JP 2000265232) in view of Sakamoto et al (JP 64039339).

Applicant submits that Kamio et al and Sakamoto et al do not disclose or render obvious the subject matter of the presently claimed invention and, accordingly, requests withdrawal of this rejection.

The present invention as set forth in claim 1 as amended above is directed to a method for producing an aluminum-alloy shaped product, comprising a step of forging a continuously cast rod of aluminum alloy serving as a forging material, in which the aluminum alloy contains Si in an amount of 10.5 to 13.5 mass%, Fe in an amount of 0.15 to 0.65 mass%, Cu in an amount of 2.5 to 5.5 mass% and Mg in an amount of 0.3 to 1.5 mass%. The aluminum alloy also contains any one, or a combination of two or more, of Ni in an amount of 0.8 to 3 mass%, P in an amount of 0.003 to 0.02 mass%, Sr in an amount of 0.003 to 0.03 mass%, Sb in an amount of 0.1 to 0.35 mass%, Mn in an amount of 0.1 to 1.0 mass%, Zr in an amount of 0.04 to 0.3 mass%, V in an amount of 0.01 to 0.15 mass% and Ti in an amount of 0.01 to 0.2 mass%, at least, the aluminum alloy containing Cr in an amount suppressed to not more than 0.5 mass%, Na in an amount suppressed to not more than 0.015 mass%, Ca in an amount suppressed to not more than 0.02 mass% and the balance comprising aluminum and an inevitable impurity. The aluminum alloy is subject to heat treatment and heating steps, wherein the heat treatment and heating steps include a step of subjecting the forging material to pre-heat treatment, a step of heating the forging material during a course of forging of the forging material and a step of subjecting a shaped

product to post-heat treatment, wherein the pre-heat treatment including treatment of maintaining the forging material at a temperature of 200 to 470°C for two to six hours.

Thus, applicant has amended claim 1 to include recitations from claims 6 to 10. In addition, applicants have amended claim 1 to recite the temperature of 200 to 470°C for the pre-heat treatment. Support for the temperature values of 200 and 470°C can be found in the Examples of the present specification. See, for example, Examples 2-2, 16 and 20.

In the Office Action, the Examiner states that with respect to present claims 1, 4-6, 8-10 and 12, Kamio et al teach a process of producing an aluminum-alloy shaped product after continuous casting the aluminum alloy comprising a preheat treatment at a temperature of 490-510 °C for 3 to 5 hours. The Examiner refers to claim 2 of Kamio et al as disclosing this temperature range. The Examiner states that even though the claimed preheat temperature range and the range disclosed by Kamio et al do not overlap, a prima facie case still exists where the claimed range and the range disclosed by the prior art are close enough that one skilled in the art would have expected the same result.

In response, although the Examiner states that even though the claimed preheat temperature range and the range disclosed by Kamio et al do not overlap, a prima facie case still exists where the claimed range and the range disclosed by the prior art are close enough that one skilled in the art would have expected the same result, applicant submits that the present specification contains evidence that the same results are not achieved and that the present invention achieves unexpected results.

Thus, Comparative Example 1 and Comparative Example 1-1 of the present specification each employed a preheat temperature of 490°C, which is within the 490-510°C range disclosed by Kamio et al. As can be seen from Table 2 of the present specification, Comparative Example

1 and Comparative Example 1-1 did not achieve the results of the Examples of the present invention which employed a preheat temperature within the range of the present claims. For example, Comparative Example 1 and Comparative Example 1-1 had a lower fatigue strength at 300°C and worse tensile characteristics at 300°C than any of the Examples of the present invention.

In addition, applicant encloses Appendix Tables 1-3 which contain data from the present specification and which contain data for new Examples 7-1 to 7-6 that has been added.

Appendix Tables 1-3 show the following facts about the effects depending on the temperature of the pre-heat treatment (homogenization treatment).

- Based on a comparison between Comparative Examples 1 and 1-1 and Examples 5 to 8, it can be seen that the homogenization treatment at a temperature of 470°C or less leads to the production of a product having higher strength than obtained at a temperature of 490°C, which is the minimum temperature disclosed in Kamio et al for the pre-heat treatment (homogenization treatment).

- Further, based on a comparison among Examples 16 to 19 of the present specification, it can be seen that the lower the temperature for homogenization treatment is, the higher the high-temperature tensile strength and high-temperature fatigue strength are, and that a similar tendency is found among Examples 20, 21 and 23.

- Still further, based on a comparison among Examples 7, 7-1 to 7-3 and 7-5, it can be seen that the closer to room temperature the temperature for homogenization treatment is, the higher the high-temperature tensile strength is.

The advantageous effects depending on the temperature of the pre-heat treatment (homogenization treatment) for the alloy of the present invention which are described above are

neither disclosed nor suggested in any of Kamio et al (JP2000265232) and Sakamoto et al (JP64039339).

Accordingly, applicant submits that the present invention achieves unexpected results as compared to Kamio et al and, therefore, is patentable over Kamio et al and Sakamoto et al.

The Examiner further states that Kamio et al do not expressly teach a continuously cast rod of aluminum alloy with the claimed composition. The Examiner relies on Sakamoto et al as disclosing a continuously cast rod of an aluminum alloy, which is suitable for forging, with a composition relative to that of the claimed invention, in weight percent, which overlaps the composition of the present claims as shown in a table that the Examiner prepared and set forth at page 3 of the Office Action.

The Examiner argues that it would have been obvious to one of ordinary skill in the art to use the aluminum alloy cast rod of Sakamoto et al in the process of Kamio et al since Sakamoto et al teach that such an aluminum alloy exhibit excellent wear resistance and forgebility by casting and heat-treating (abstract).

In addition, the Examiner states that the amounts of Si, Fe, Cu, Mg, Ni, Sr, Mn and Al disclosed by Kamio et al in view of Sakamoto et al overlap the claimed amounts of Si, Fe, Cu, Mg, Ni, Sr, Mn and Al of the instant invention, which is prima facie evidence of obviousness The Examiner argues that it would have been obvious to one of ordinary skill in the art to have selected claimed amounts of Si, Fe, Cu, Mg, Ni, Sr, Mn and Al from the amounts disclosed by Kamio et al in view of Sakamoto et al. because Sakamoto et al disclose the same utility throughout the disclosed ranges.

As discussed above, applicant has amended claim 1 to include recitations from claims 6 to 10, such as the aluminum alloy can have the composition defined in original claim 8, such as

the aluminum alloy used can contain Sb in an amount of 0.1 to 0.35 mass%. Applicant has also added new claim 17 that requires the presence of Ni and P, and new claim 18 that requires the presence of Sr.

According to Tables 1-I, 1-II and 2 of the present specification, the products of Examples 11 and 13 comprise an aluminum alloy containing strontium (Sr) (Example 11) and antimony (Sb) (Example 13), but containing no phosphorus (P). However, for the high-temperature tensile strength and high-temperature fatigue strength, the products of Examples 11 and 13 are superior to those of Examples 16 to 20 comprising an aluminum alloy containing no Sr or Sb, but containing P. See Table 2 of the present specification.

On the contrary, Kamio et al disclose that Comparative Product A containing Sb, but containing no P is inferior to Inventive Products C to G containing P in an amount of 0.0065 to 0.0098 wt% in terms of the high-temperature tensile strength and high-temperature fatigue strength. See paragraph [0020] and Tables 1 and 3 of Kamio et al.

Further, Kamio et al neither disclose nor suggest an aluminum alloy containing Ni. However, the present specification discloses that an aluminum alloy containing P and Ni within the ranges of the composition specified in claim 1 of the present application can be used to produce an aluminum shaped product having excellent high-temperature tensile strength, according to the present invention, as in Examples 5 to 10 shown in Table 1.

Thus, Kamio et al do not render obvious claim 6 directed to an aluminum alloy containing Ni or claim 17 directed to an aluminum alloy containing Ni and P, or claim 18 directed to an aluminum alloy containing Sr.

Accordingly, Kamio et al do not suggest the composition of the aluminum alloy within the scope of claim 1 of the present application and set forth in various dependent claims of the present application.

The Examiner has relied on Sakamoto et al for a disclosure of various components and amounts of an aluminum alloy and argues that it would have been obvious to modify Kamio et al in view of the Sakamoto et al disclosure.

Applicant submits that one of ordinary skill in the art would not have been led to combining the teachings of Kamio et al and Sakamoto et al, and that even if the teachings were combined, one of ordinary skill in the art would not been led to present invention.

Thus, Kamio et al do not disclose the conditions for cooling a molten aluminum alloy when continuously casting the molten alloy.

On the other hand, the invention disclosed in Sakamoto et al requires that the casting temperature range from 670 to 850°C, and the cooling treatment be performed at a cooling speed of 5°C/sec. or higher within the temperature range of from 670 to 554°C and at a cooling speed of 10°C/sec. or higher within the temperature range of from 560 to 554°C (claim 2).

Further, the aluminum alloy used in the invention of Sakamoto et al contains Sr in an amount of 0.005 to 0.1 wt% as an essential component (claim 1), but Sakamoto et al nowhere disclose an aluminum alloy containing P.

On the other hand, while the invention disclosed in Kamio et al indispensably requires an aluminum alloy containing P as stated above, Sakamoto et al do not disclose an aluminum alloy containing P.

Accordingly, one of ordinary skill in the art would not have been led to combining the teachings of Kamio et al and Sakamoto et al.

With respect to the presence of Ni, Sakamoto et al disclose the use of Ni at page 6 of the translation as an optional component in an aluminum alloy that does not contain P, but Sakamoto et al do not contain any working Example of an alloy containing Ni.

Since Sakamoto et al do not disclose any inventive example composed of an aluminum alloy containing Ni, it cannot specifically be known from Sakamoto et al how much the addition of Ni to the aluminum alloy composition can increase the strength of a product made of the alloy.

Accordingly, applicant submits that the composition of an aluminum alloy within the scope of claim 1 of the present application and containing Ni as recited in claim 6 and Ni and P as recited in claim 17, or Sr as recited in claim 18, would not have been not obvious to those skilled in the art from Kamio et al or Sakamoto et al.

As discussed above, while the aluminum alloy disclosed in Sakamoto et al must be cooled at a predetermined cooling speed as stated above, Kamio et al do not disclose the conditions for cooling a molten alloy. Further, the production method disclosed in Kamio et al is an invention indispensably requiring the use of an aluminum alloy containing P.

Accordingly, it is anticipated that even if the aluminum alloy disclosed in Sakamoto et al is applied to the production method disclosed in Kamio et al, no product having a preferable given strength can be obtained.

In view of the above, applicant submits that the present invention was not obvious to one of ordinary skill in the art from the disclosures of Kamio et al and Sakamoto et al and, accordingly, requests withdrawal of this rejection.

Claim 13 has been rejected under 35 U.S.C. 103(a) as being unpatentable over Kamio et al (JP 2000265232) in view of Sakamoto et al (JP 64039339) as applied to claim 1 above, and further in view of Evans et al (US7267734).

The Examiner states that Kamio et al and Sakamoto et al are silent about the casting speed. The Examiner relies on Evans et al as teaching that casting speed is a result effective variable since it affects the intermetallic phases of the alloy, as shown at column 3, lines 65-67 and column 4, lines 1-3. The Examiner argues that it would have been obvious to one of ordinary skill in the art to have optimized the casting speed of Kamio et al in view of Sakamoto et al in order to achieve desired intermetallic phases of the aluminum alloy.

Claim 13 depends from claim 1. Accordingly, applicant submits that it is patentable for the same reasons as set forth above for claim 1.

Further, applicant submits that one of ordinary skill in the art would not have combined Evans et al with Kamio et al and Sakamoto et al. Thus, Evans et al do not disclose an alloy having an Si content of 10.5 to 13.5 mass %, but disclose a much lower Si content of 0.05 to 0.20 %.

In addition, the disclosure at column 3, lines 65-67 and column 4, lines 1-3 in Evans et al pointed out by the Examiner refers to the effect of the casting speed on the intermetallic phase. However, the disclosure in Evans et al has no relation to the effect contributing to the formation of the crystallization product networks in an alloy. See page 30, lines 13-14 in the present specification.

Accordingly, applicant submits that one of ordinary skill in the art would not have been led to optimizing any crystallization product networks in an alloy of Kamio et al by optimizing the casting speed employed in the production method disclosed in Kamio et al, even in view of the disclosure of Evans et al or Sakamoto et al.

Still further, the highest casting speed disclosed in Evans et al is 100mm/min for DC casting. Applicant has added a new claim 20 that recites a casting speed of 300 to 2,000

mm/min, as disclosed at page 30 of the present specification. Evans et al do not suggest such a casting speed.

In view of the above, applicant requests withdrawal of this rejection.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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(Appendix table 1)

	Pre-heat treatment (homogenization treatment)						Percent reduction during upsetting	Post-heat treatment (T6 treatment)		
	490°C	470°C	440°C	400°C	370°C	200°C or lower		Solid Solution	Quenching	Aging
Comp. Ex. 1	○	–	–	–	–	–	50%	○	○	○
Comp. Ex. 1-1	○	–	–	–	–	–	87.5%	○	○	○
Ex. 5	–	–	–	–	○	Room temp.	50%	○	○	○
Ex. 6	–	–	–	–	○	–	87.5%	○	○	○
Ex. 7	–	–	–	–	○	–	50%	○	○	○
Ex. 8	–	–	–	–	○	–	87.5%	○	○	○
Ex. 7-1	–	–	–	–	–	Room temp.	50%	○	○	○
Ex. 7-2	–	–	–	–	–	200°C	87.5%	○	○	○
Ex. 7-3	–	–	–	–	–	100°C	50%	○	○	○
Ex. 7-4	–	–	–	○	–	–	50%	○	○	○
Ex. 7-5	–	–	–	–	–	Room temp.	50%	–	–	○
Ex. 7-6	–	–	–	–	○	–	50%	–	–	○
Ex. 9	–	–	–	–	○	–	50%	○	○	○
Ex. 10	–	–	–	–	○	–	50%	○	○	○
Ex. 11	–	–	–	–	○	–	50%	○	○	○
Ex. 12	–	–	–	–	○	–	50%	○	○	○
Ex. 13	–	–	–	–	○	–	50%	○	○	○
Ex. 14	–	–	–	–	○	–	50%	○	○	○
Ex. 15	–	–	–	–	–	Room temp.	50%	○	○	○
Ex. 16	–	○	–	–	–	–	50%	○	○	○
Ex. 17	–	–	○	–	–	–	50%	○	○	○
Ex. 18	–	–	–	○	–	–	50%	○	○	○
Ex. 19	–	–	–	–	○	–	50%	○	○	○
Ex. 20	–	○	–	–	–	–	50%	○	○	○
Ex. 21	–	–	○	–	–	–	50%	○	○	○
Ex. 22	–	–	○	–	–	–	87.5%	○	○	○
Ex. 23	–	–	–	○	–	–	50%	○	○	○

Compositional Proportions (mass%)												Metallographic structure
Si	Fe	Cu	Mn	Mg	Ni	V	Zr	Ti	P	Sb	Sr	
11.7	0.17	4.0	0.23	0.42								△×
do.	do.	do.	do.	do.								△×
11.9	0.23	3.3		0.87	2.4	0.1	0.12		0.006			○
do.	do.	do.		do.	do.	do.	do.		do.			○△
12.8	0.49	3.8	0.23	1.09	2.0			0.1	0.009			○
do.	do.	do.	do.	do.	do.			do.	do.			○△
do.	do.	do.	do.	do.	do.			do.	do.			○
do.	do.	do.	do.	do.	do.			do.	do.			○
do.	do.	do.	do.	do.	do.			do.	do.			○
do.	do.	do.	do.	do.	do.			do.	do.			○
do.	do.	do.	do.	do.	do.			do.	do.			○
do.	do.	do.	do.	do.	do.			do.	do.			○
13.4	0.61	4.1	0.32	1.21	2.2				0.01			○
11.0	0.25	3.0	0.10	0.40	1.8				0.01			○
do.	do.	do.	do.	do.	do.						0.015	○
11.8	0.33	3.3		0.72	2.2				0.005			○
11.8	0.33	3.3		0.72	2.2					0.2		○
13.4	0.61	4.1	0.32	1.21	2.2				None.			○
11.5	0.19	5.1	0.21	1.14	0.9				0.007			○
12.3	0.3	3.3	0.15	0.85	1.8			0.05	0.005			○△
do.	do.	do.	do.	do.	do.			do.	do.			○
do.	do.	do.	do.	do.	do.			do.	do.			○
do.	do.	do.	do.	do.	do.			do.	do.			○
12.8	0.45	3.8	0.25	0.9	2.1				0.01			○△
do.	do.	do.	do.	do.	do.				do.			○
do.	do.	do.	do.	do.	do.				do.			○△
do.	do.	do.	do.	do.	do.				do.			○

(Appendix table 2)

300°C tensile characteristics			300°C fatigue strength (10^7)
σ_B(MPa)	$\sigma_{0.2}$(MPa)	δ (%)	σ_w(MPa)
62	42	37.9	35
60	40	38.8	34
80	51	19.1	56
77	47	20.0	54
82	53	17.5	58
79	50	18.9	56
85	56	16.7	46
83	54	17.1	45
84	55	17.0	46
80	50	17.4	43
86	53	14.4	52
85	52	15.0	51
85	56	16.8	60
77	48	18.2	51
79	48	18.6	55
81	50	17.6	57
80	50	18	60
84	55	16.0	59
80	52	17.4	50
72	42	23.4	48
74	45	21.8	50
76	47	19.2	52
77	49	18.4	53
75	45	22.0	49
78	50	19.5	54
76	47	20.6	51
80	52	17.9	56

(Appendix table 3)

Eutectic Si			Intermetallic compound		
Average particle diameter (μm)	Area share (%)	Proportion of substances having acicular ratio of 1.4 or more (%)	Average particle diameter (μm)	Area share (%)	Proportion of substances having length of 3 μm or more (%)
2.1	9.6	21.1	1.7	1.0	22.3
3.0	9.3	65.4	2.8	4.2	50.3
3.2	9.2	67.8	3.1	4.3	56.2
3.1	9.7	45.2	2.7	4.3	40.5

* The tensile test and fatigue strength tests at 300°C were performed after the test piece was preliminarily heated to 300°C for 100 hours.